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*Main Article:*

# **Astronomy Education: Becoming a Hybrid Researcher**

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## **Abstract**

This article describes the experiences of a former astronomer who is making the transition to astronomy education research as an international graduate student in the United States. The article describes the author's encounters with education research, its methodologies, and his changing research interests as he progresses through the graduate program. It also describes his experiences with the busy life of a graduate student in American academia and his experiences as an international student.

**Keywords:** changing research field; international student; graduate student research; science education research; astronomy education research; interdisciplinary research

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## **1. Introduction**

I came to the United States in early 2004 to join the Conceptual Astronomy and Physics Education Research (CAPER) Team at The University of Arizona, as a graduate student to pursue my two great passions in life: astronomy and education. In my home country, the Netherlands, I obtained both a master's degree in astronomy and a teaching certification in physics; but research opportunities in astronomy education, the study of teaching and learning astronomy, were slim. The research field is very new and not many groups around the world are involved. When I found out about the CAPER Team, I saw the possibility of fulfilling my dream of achieving a PhD doing astronomy education

research. In this article, I will describe my experiences as an “international” doctoral student in the US as well as my transformation to an astronomy education researcher, a hybrid between astronomer and educator--part scientist and part scholar.

## 2. Astronomy Education

The CAPER Team is in an odd but very interesting position within the university. Although the team is formally a part of the department of astronomy, graduate students in the CAPER Team are not, because the university does not have a doctoral program in astronomy education. Most of us are in the department of Teaching and Teacher Education. We are an interdisciplinary group truly in between the two departments (and the colleges of science and education).

Because astronomy education research is such a young field, most of its practitioners come into the field from a variety of backgrounds. We bring a variety of views on and opinions about research with us. On the one hand are the educational specialists, who know much about education, but not necessarily about astronomy. On the other hand are the astronomers, who know much about astronomy, but not necessarily about education. To get ahead as a research field we need hybrids: researchers who have a background in both astronomy and education, people able to speak both the languages of education research and astronomy research, and are familiar with the commonly used methodologies in both the fields. We need to be masters of both the contributing fields to move astronomy education forward to the point that it becomes an independent and viable interdisciplinary field of study in its own right.

One of the more fundamental challenges I ran into was the perceived need to be seen as professional researchers by both the communities, to have the research methods and results accepted as valid by both astronomers and educators. Both fields have seen more than their fair share of well-intentioned people who are not backed by professional knowledge or skills, yet feel the need to get involved. As a result, both fields are a bit weary of researchers entering without proper credentials relevant within the respective fields. I feel strongly that my background in astronomy made it easier for astronomers to accept both me and my work. The impression I get is that I am being seen as an astronomer who decided to go into another field. I do not have to prove my research credentials again, as I am one of “them.”

I think that in order for astronomy education to be a respected field, it would do well to look at the German tradition of *Fachdidaktik*, literally meaning “content didactics.” This tradition, which is also followed in the Netherlands, studies the teaching and learning of a specific content area, in this case astronomy. Its practitioners are specialists in both astronomy and educational content. That is how I have come to see my work. Having completed my master-level studies in astronomy, I am now learning about education, which has turned out to be an altogether new experience.

### **3. Starting Research**

When I moved to the US, not only was the country foreign to me, but I also entered a new academic field by switching from astronomy to science education. In the beginning, I had a hard time trying to figure out what constitutes valid research in science education, what avenues of investigation are worthwhile to pursue and what the proper methods are to do research. Education research is considerably different from astronomy research. One cannot directly intervene in astronomical events; one cannot experiment, only observe and model, whereas in education interventions are not only possible, but commonly used. Also, education research is complex in the sense that one is dealing with self-aware, social humans who are able to interact with the researcher and research environment. Astronomy typically does not have to worry about the socio-dynamical aspects of a research setting.

At first, I felt insecure about doing research at all because I was new in the field and did not have any real background in education research. Although my supervisors would have preferred me to learn education research by doing it, I just did not, and still do not, feel comfortable in such a situation. It seemed odd to me to start doing doctoral-level work without a thorough grounding in the field. In the Netherlands, a PhD requires 4 years of full-time research after a master's degree. I continued to take classes to get to a master's level background knowledge in education, which I believed to be a prerequisite before starting to do research. The system in the US works differently: a master's degree is not always a prerequisite for entering into a PhD program.

### **4. Doing Research**

There is a limit beyond which taking time to get ready to do research can amount to putting research off because one still feels insecure. At some point I really needed to get research done. When I first thought about doing research, it seemed natural to keep doing quantitative work, gathering sets of numerical data through surveys and doing statistical analyses of data sets. That was the only type of research I was familiar with and which I could relate to my previous experiences with research in astronomy. It was not until I took my educational methodology classes that I learned about “qualitative” research methods: the analysis of (the meaning of) words. At first they did not appeal to me so much because I was not familiar with them. My personal mental shift came when I worked on a small project using qualitative methods to study an individual classroom and an individual instructor. I discovered how powerful qualitative methods could be for answering certain research questions and for getting an in-depth view on a particular situation, in this case the implementation of a set of curriculum activities in a classroom.

It will be hard to convince the astronomy community about the validity of qualitative research, as the methodology is not used in astronomy at all. One of my colleagues, also an astronomer by training, has run into this problem as well. Her dissertation is completely qualitative and she has some problems explaining the research methods to her former astronomy colleagues. As a side project, we are currently working on a paper to explain the qualitative approach and its uses to scientists.

My first education research project was a short, quantitative project: a statistical analysis on a large data set. Doing such a project served two purposes. First, it allowed me to use the research skills I had already obtained in astronomy. Second, it served to help boost my confidence doing work in science education and giving me an idea on the field of science education. In this project, the data were collected several years ago to answer different research questions, and I encountered the frustration that the best ideas about data collection often come up during data analysis, when it is no longer possible to change the way the data were collected. Although this happens in every field, it takes time to learn to accept a less than perfect data set and work from there. I do typically enjoy the challenge of working with advanced analysis techniques and opening the full box of tricks to get the best possible results from imperfect data, but the process is very time-consuming.

That first experience with education research strengthened my conviction that in education research one has to have a good background in the field before designing and doing research projects. Though it may be a good learning experience to make mistakes and work with less-than-perfect designs, in graduate school one can barely afford to waste time.

## **5. Changing Research Interests**

During the years I was taking my course work in education, I found that my research interests shifted considerably. I started from a more quantitative and statistical approach to astronomy education research, but became increasingly interested in more qualitative and theoretical work. This was mostly due to one of my professors in educational psychology, who opened up the fields of learning theory and motivational theory to me. In astronomy I have always been much more interested in the observational than the theoretical side. However, in education, I find myself more at home in the theoretical aspects of educational psychology and curriculum studies. Today, I consider myself to be an educational theorist, to my own great surprise.

I am now at the stage of defining a dissertation topic. When I was talking with my supervisors about this, I found it really difficult to frame a good research question. I have the tendency to think too broadly and will have to learn how to focus on one or two questions, and pay attention to measurable answers to those questions. I need to heed the advice of one of my former supervisors who told me to “stop building empires.” It is much harder than I thought it would be, although I partly blame my own changing research interests. My supervisors, so far, have been supportive and have given me the time to decide what I want.

## **6. Adjusting to American Academic Life**

Academic concerns like the ones mentioned above are not the only things I struggled with. Doing graduate work in another country poses two distinct, and yet sometimes related, challenges. I had to adjust both professionally and socially. Working in American academia is different from working in academia back home in the Netherlands. For

example, in the Netherlands, most of the research is government funded and academics (including PhD students) are civil servants. In the US, a lot of money comes from grants which are limited in size and duration, This means that professors spend more time writing proposals to obtain funding than actually doing research. Good research takes time and, in my opinion, should not be dictated by the deadline of a grant. This means that a paper gets submitted for publication not because the research has come to a publishable state, but because the grant has expired and the research project has ended. How some of these hastily written papers make it past peer review is beyond me. However, if one does not write those papers or create the products, one would not get another grant. It is the “publish or perish” culture that is new to me and I am not sure that I like it very much.

Another thing that strikes me as odd is the phenomenon of summer salaries that exists at least in my field. Rather than working on a 12-month schedule like I was used to, all research, dissertation writing, and normal academic work get disrupted in the summer months. We all must find different projects during this period. These projects may have nothing to do with one’s line of work or interest but they pay the bills. When the Fall semester starts it takes a few weeks to start up again, adding to the amount of time diverted from the dissertation project.

With all those kinds of new things to get used to, I was lucky to find an informal mentor, someone who is not in the formal line of supervision, but still a senior of sorts. She helped me adjust to and navigate the American academic climate, especially in dealing with the expectations and responsibilities of a graduate student which are somewhat different from those in the Netherlands.. Apart from this informal mentor, I also get a lot of support from my fellow graduate students and professors in education, who help me in areas where my background knowledge is lacking, for example vis-à-vis the American school system. Most of my education classes implicitly assume an American background, and as I have not gone through the American educational system, I get confused every now and again. Both my colleagues and my professors have gotten used to me making a “time-out” gesture and my phrase “subtitles for the foreigner.”

## **7. Being an International Student**

Being in a foreign country to do one’s doctoral work poses some non-academic challenges as well. Research is always done within a social setting and cultural environment. I was warned before I came to the US that irrespective of how well you speak the language or how well you think you know the culture, there will be episodes of culture shock. It is the feeling of not fitting in, being very irritable (on top of being irritable due to the regular stress of graduate life), and in general the feeling that there is nothing you would rather do than run to the airport and get on a plane back to the place where people actually make sense and speak a normal language. I was no exception to that rule and my academic work suffered in these periods. I lacked the motivation to go to class, teach, or do research. In those moments, I found help and comfort in my friends, both American and those both from back home. There are things one can discuss with friends that one cannot discuss with colleagues or supervisors.

## 8. What Life?

Doing a PhD is demanding and time consuming. One of the things I learned the hard way is how important it is to be able to balance professional and personal life, and to take time off from work. During one semester, I took on considerably more work than I should have. I found it hard to say no to interesting projects and severely overextended myself. I had to take a few steps back (on doctor's orders) to realize that I needed to better balance my life. It cannot be all work. There was more than a hint of irony in a recent online "you just might be a graduate student if" list where one of the characteristics was that "you have accepted guilt as an inherent feature of relaxation". I need to remind myself from time to time that a day only has 24 hours, 8 of which should preferably be spent unconscious. I have become more relaxed in my approach to work. If I cannot finish it today, I will finish it tomorrow.

A contributing factor to the pressure is that the system in the US requires me to not only do research and take classes, but also work for 20 hours a week for funding. Luckily, being a teaching assistant usually is relevant to my research, but I still feel the pressure of being partly responsible for a course serving 150 students. I am a teacher at heart, I love to teach and help my students understand the material, and I refuse to let them down.

As a result of these pressures, put on us by either ourselves or others, all graduate students I know, both in the US and in the Netherlands, have gone or will go through periods of severe self-doubt, usually around the midpoint in their graduate student careers. It is the feeling of being lost, being stuck in research without having a clue as to what one is actually doing, or why, and not seeing a way out. In the Netherlands it is commonly referred to as the *aio-dip* (pronounced aye-o dip) by graduate students. "Aio" is a Dutch acronym that means PhD student. "Dip" means a small depression, in both the physical and mental sense of the word. I found it oddly comforting to know that the aio-dip is so common among graduate students. At least I knew that I was not alone when I seriously questioned if I should continue with the program. Luckily we have a good group of graduate students. They are very supportive of each other and we can recognize when someone is on the verge of going into an aio-dip, so we can help one another out in these moments of gloom.

## 9. Lessons Learned

I have found it a hard job to be an international graduate student in a research field different from the one in which I was originally trained. It has challenged me both on professional and personal levels. For me, being in graduate school is a job, consisting of taking classes, teaching, and doing research. But it is a job I enjoy and in which I enjoy a lot of autonomy. Though my supervisors advise and guide me, the final decision on what to do and how to do it is mine to make. I have gone through culture shock, both professionally and personally, and I now know who to call and what to do when the next shock comes. Professionally, I have learned that I have the potential to become a career academic in my field, which has boosted my confidence considerably. I am no longer an astronomer, but I am not the usual education graduate student either. I am becoming an

astronomy educator, a hybrid between a scientist and a scholar in whom the two specialties of astronomy and education are blended together, preparing myself to do research on the teaching and learning of astronomy concepts.

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